INDIAN AND NORTHERN AFFAIRS CANADA
NORTHERN AFFAIRS PROGRAM

SUMMARY REPORT:
DRILLING FLUID ADDITIVE USE
AND WASTE DISCHARGE IN
ARCTIC MARINE WATERS
NORTH OF 60°
FOR 1985

ARCTIC WATERS
WATER RESOURCES DIVISION

OCTOBER 1986

ABSTRACT

The Canadian Oil and Gas Lands Administration (COGLA) requires hydrocarbon exploration operators to report data on drilling fluid additive use at, and waste discharge from, all operations offshore. This report summarizes these reports, from the four (4) operators active in hydrocarbon exploration activities in arctic marine water North of 60° for the year 1985. It also identifies problem areas encountered and recommendations for future reports.

This report is the fourth in a series produced by Arctic Waters, Regulatory Approvals Section, Water Resources Division of the Department of Indian Affairs and Northern Development - Northern Affairs Program.

Edwards, D.L.S. 1986 "Summary Report: Drilling Fluid Additive Use and Waste Discharge in Arctic Marine Waters North of 60° for 1985" - Arctic Waters, Regulatory Approvals Section, Water Resources Division, Northern Affairs Program, Indian and Northern Affairs Canada, Yellowknife, N.W.T., 42 pages.

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1.0 INTRODUCTION

The Canada Oil and Gas Lands Administration (COGLA) requires all hydrocarbon exploration companies conducting operations on Canada Lands, to obtain an Authority to Drill a Well (ATDW) which is issued under the authority of the Canada Oil and Gas Act. Attached to offshore ATDW are a series of Environmental Operating Conditions (EOC) which are supplied to COGLA by the Department of Indian Affairs and Northern Development - Northern Affairs Program (DIAND-NAP), and are developed through consultation with an interdepartmental committee with public representation, the Arctic Waters Advisory Committee (AWAC). One aspect of these EOC requires a prediction of, and an accounting for, drilling fluid additive use. These requirements are typically represented as follows (Tables showing summaries are noted in brackets):

1) Prior to spud date, the Operator shall submit to the Conservation Engineer a list of drilling fluid additives and base materials anticipated to be used in the drilling mud program, and the expected mass or volume of each component. (Tables 6-9.)

2) The Operator shall determine the total volume of drilling wastes and muds deposited into arctic waters and submit a report to the Conservation Engineer within ninety (90) days of rig release that shall include but not be limited to the following:

a) the daily and total volume of drilling wastes discharged; (Tables 10-13)
b) the volume of mud tank contents discharged and the date and reason for discharge;
c) the total mass of each mud additive, specialty compound or other products used in the mud system including the type and amount of oil from all sources entering the drilling fluid; and (Tables 2-5)
d) the volume of hydraulic fluid discharged to arctic waters during the operation of the blowout preventor stack and the date of each discharge. (This condition is applied only to those operations which have a subsea BOP, e.g. floating platforms.)

This report provides summaries of all data submitted by all operators for wells spudded during 1985 and comparisons are made between the actual and estimated drilling additive use. As well, some statistics are derived and provided.

2.0 DRILLING OPERATIONS FOR 1985

Thirteen wells were drilled during 1985 by four operators active in the Canadian arctic offshore North of 60°. The wells are listed by operator below, with spud/reentry and rig release dates. (Note: If a well was spudded/re-entered in 1985 and was not released until 1986, the well is considered to have been entirely drilled in 1985)

Dome Petroleum Limited - (Calgary, Alberta)

Adlarktok P-09	85-08-08,	85-10-17
Arluk E-90	85-09-24,	85-10-13
Edlok N-56	85-08-10,	85-09-16
Havik B-41	85-08-22,	85-09-30
Nerlerk J-67	85-08-17,	85-10-23

Esso Resources Canada Limited - (Calgary, Alberta)

Adgo G-24	85-10-07,	86-01-07
Minuk I-53	85-11-27,	86-05-02
Nipterk L-19A	85-04-21,	85-07-21

Gulf Canada Resources Inc. - (Calgary, Alberta)
(Note: Does not include Amauligak I-65 - information unavailable at this time. It will be included in the 1986 summary reports)

Aagnerk E-56	85-10-28,	85-11-10
Akpak P-35	85-06-10,	85-07-07
Akpak 2P-35	85-07-08,	85-08-14

Panarctic Oils Ltd. - (Calgary, Alberta)

Cape Allison C-47	85-01-31,	85-05-08
East Drake L-06	85-02-15,	85-04-16

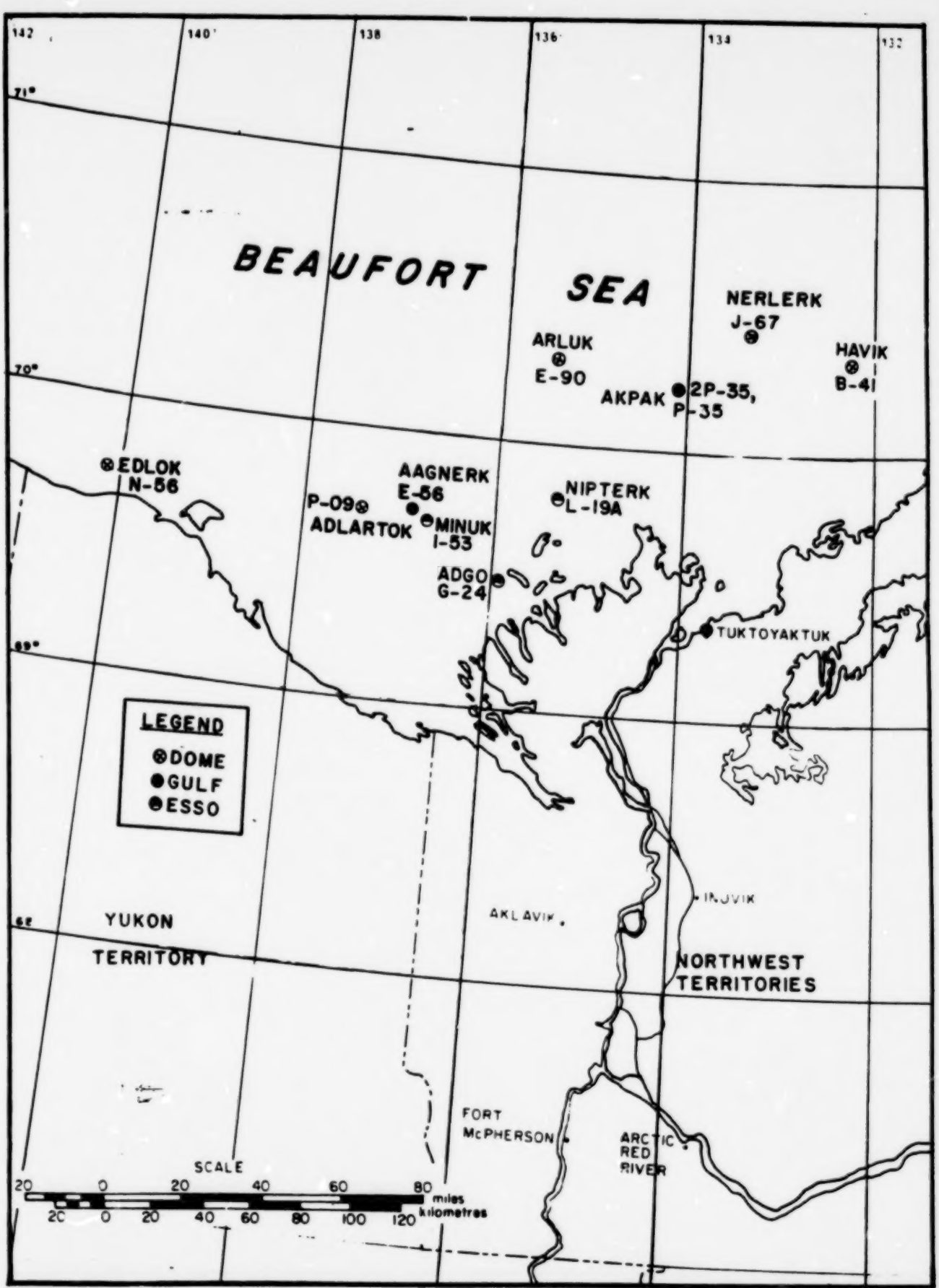

Figure 1: Location of Wells - Beaufort Sea - Dome Petroleum Limited, Esso Resources Canada Limited and Gulf Canada Resources Inc.

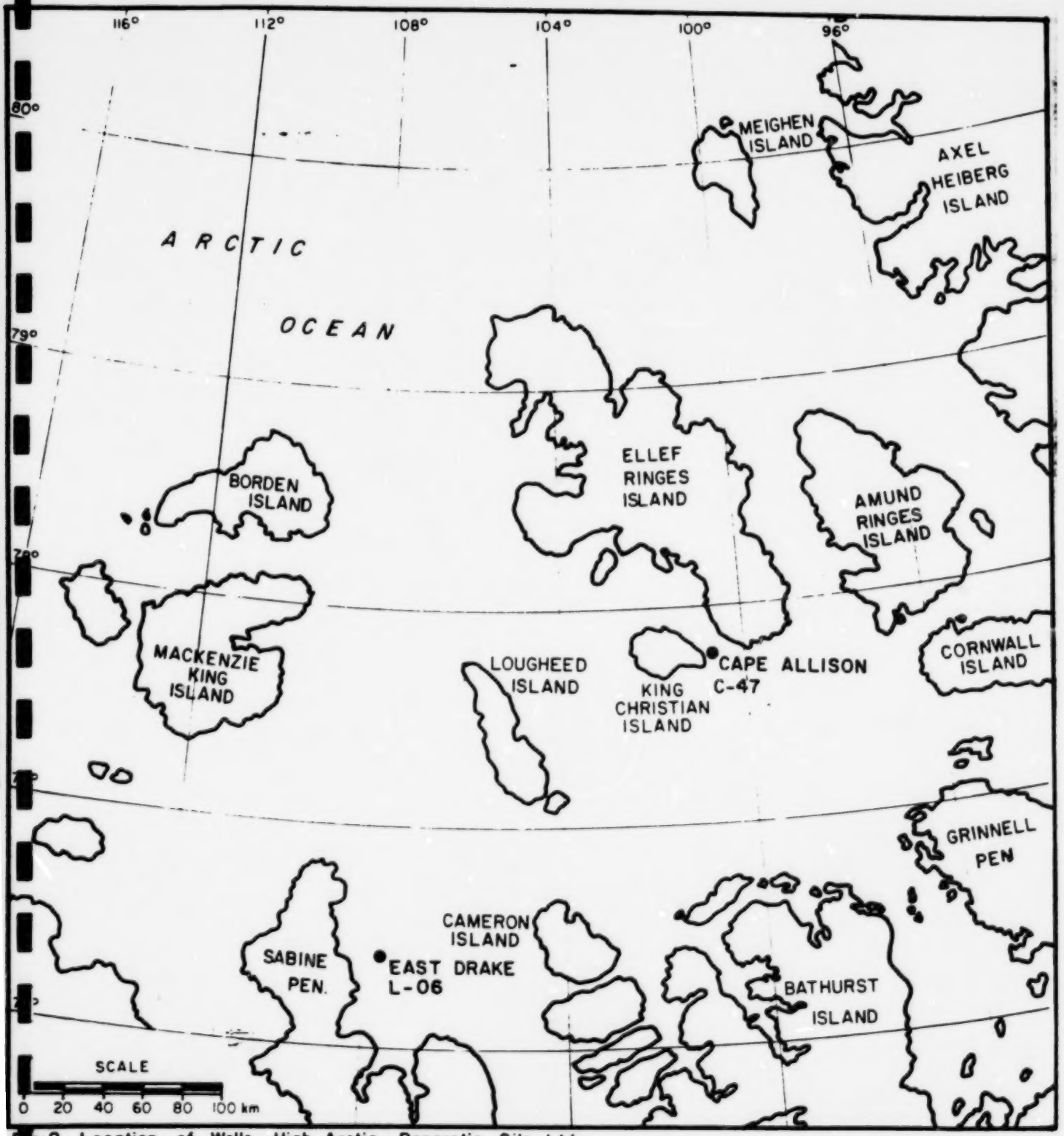

Fig:2 Location of Wells - High Arctic - Panarctic Oils Ltd.

3.0 DATA TREATMENT

As with the three previous reports prepared by Arctic Waters, Water Resources Division (Milburn and Edwards 1986, Milburn and Edwards 1985, and Evans and Milburn 1983), this report serves as a first step in data reduction. Some limited statistical analysis was performed, e.g. some comparison between estimated and actual use (Tables 6 to 9B, pgs. 21 to 28) and some regression analysis (Figures 3 through 9, pgs. 36 to 42) for the major drilling components barite, bentonite, bicarbonate of soda, caustic soda, KCl/potash, soda ash and XC polymers. (It should be noted that the regression was done with the data - well depth, additive use - from 1983 to 1985). Also included in the data, is a summary of the more toxic (96 hr. LC_{50} of less than 1000 ppm) drilling additives (Table 14, p.34).

4.0 TRENDS OBSERVED

1) Oil Based Muds:

The first regular, albeit on a largely experimental basis, use of oil based muds (OBM) was noted in 1985. Esso Resources Canada Limited (ERCL) used OBM for their three wells. As the technology and the components of OBM are new, ERCL had to agree to a number of studies of the effects of OBM discharged at Minuk and were prohibited from, or chose not to, discharge any OBM wastes at their other sites (see Table 11, p.31).

2) "Low Toxicity" Additives:

The operators have, with encouragement from regulatory agencies, made a concentrated effort to lessen, or eliminate the use of many of the additives that had low 96 hr. LC_{50} levels. When 1983 and 1984 figures are compared to the 1985 use figures, there is a general trend shown indicating that the operators use less of the more toxic additives, e.g. diesel, B-free, etc. As well, many of

the new additives, e.g. VISTA ODC - an OBM additive, are less toxic than their predecessors, even those used in the same season e.g. Turbo A-1 and DMO 75.

3) Quality of Reporting:

In 1985 there was a continuance of the trends reported in 1984 in regards to the quality of information supplied by the operator. Almost all data supplied was in SI units and complete and accurate summary sheets were provided.

4) Correlation between Actual and Estimated Additive Use:

It was found that, as with previous years, there is again a wide gap between what is predicted to be used and what actually was used. One must remember that, as many of these operations are isolated and transport to them is difficult and/or costly, the operator must prepare his initial supply of additives to cover many contingencies, hence the operator does not use many of the additives stored simply because the contingency for which they would have been needed did not occur.

5) Correlation between Depth and Additive Use:

As the drilling programs are very different from each other, encountering different problems and downhole conditions, similarities and trends between the programs are slight.

As well, company philosophies are very different, each expressing different preferences for additives. These differences will also be reflected in a lack of trends and correlations between well depth and additive use. Only in the major components; barite, bentonite, bicarbonate of soda, caustic soda, KCl/potash, soda ash and XC polymers; is there any trend seen (Figures 3 to 9, pgs. 36 to 42), and even that is weak in most cases. Simply put, to predict the use of any one additive based on past historical and statistical trends, would be difficult and/or impossible (Figure 4, p. 37).

5.0 RECOMMENDATIONS/CONCLUSIONS

1. To use this report's data to predict future additive use and waste disposal would be difficult. It is recommended that this report and future similar reports be used as a source of information rather than a precise tool of prediction.

2. From the data examined for this report, it appears that the industry is substituting less toxic additives for the more toxic substances used in previous years.

REFERENCES CITED

Milburn, D. and D.L.S. Edwards, "Summary Report: Drilling Fluid Use and Waste Discharge in Arctic Marine Waters North of 60° for 1984", Department of Indian Affairs and Northern Development, Yellowknife, NWT, Internal Report, 1986.

Milburn, D. and D.L.S. Edwards, "Summary Report: Drilling Fluid Use and Waste Discharge in Arctic Marine Waters North of 60° for 1983", Department of Indian Affairs and Northern Development, Yellowknife, NWT, Internal Report, 1985.

Evans, T.B. and D. Milburn, "Drilling Mud Usage and Discharge in Arctic Marine Waters North of 60° for the Period 1978-1982", Department of Indian Affairs and Northern Development, Yellowknife, NWT, Internal Report, 1984.

6.0 APPENDIX I

DRILLING FLUID ADDITIVES REPORTED BY ONE OR MORE OPERATORS

Drilling fluid Additives Reported by One or More Operators

Drilling Fluid Additive	Function
Aluminum Stearate	Defoamer
AP-21 (Liquid & Solid)	Filtrate Reducer
Attapulgite Gel	Viscosifier
Barabuf	Wetting Agent
Bardac 2250	Bactericide
Barite	Weighting Material
Bentonite	Viscosifier, Filtrate Reducer
B-Free; Regular, Heavy Waste	Surfactant, Lubricant
Bicarbonate of Soda	Calcium Treating
Biotrol	Bactericide
Brine	Hole-Cleaning Mud Base
Calcium Carbonate	Fluid Loss Control
Calcium Chloride	Brine Solution
Capyrl Alcohol	Defoamer
Caustic Soda	pH Control
Carbonox	Filtrate Reducer, Dispersant
CMC	Filtrate Reducer
D-Foamer	Defoamer
Densimix	Weighting Agent
Desco	Thinner
DF-Vis	Filtrate Reducer, Viscosifier
Diesel	Lubricant
DMO-75	Base Oil for Mud
Drispac - Reg., Superlo	Filtrate Reducer, Viscosifier
Duratone HT	Fluid Loss Control
DX-10	Surfactant
Envirospot	Emulsifier
EZ Mul NT	Emulsifier
EZ Spot	Emulsifier
FLR-100 (FLR-100E)	Lost Circulation Material
Foam Kontrol	Surface Active Liquid Defoamer
Geltone II	Viscosifier
Gilsonite	Lost Circulation Material, Shale Control

Hematite	Weighting Material, Lost Circulation Material
IDFLO	Lost Circulation Material
IDF-Thin	Dispersant
Ivermul NT	Emulsifier
KCL (Potassium Chloride)	Shale Inhibitor, Freeze Dispersant
Kelzan XC/XCD/XCL	Viscosifier
KID-97	Viscosifier
Kwik Seal	Lost Circulation Material
Lime	pH Control
Magconol	Defoamer
Mica	Lost Circulation Material
N'oxygen	Corrosion Inhibitor
Nut Plug	Lost Circulation Material
Paraformaldehyde	Bactericide
Peltex	Thinner, Dispersant
Poly RX	Dispersant
Primol	Emulsifier
Resinex	Dispersant
Safeguard 5000	Flocculent
SAPP	Lost Circulation Material
Sawdust	Viscosifier
Shale Kontrol	Shale Inhibitor
Soda Ash	Calcium Treating
Sodium Nitrate	Tracing Fluid
Sodium Sulphite (Sulfite)	Corrosion Inhibitor
Soltex	Mud Conditioner
Spersene	Filtrate Reducer, Dispersant
Spud Mud	Viscosifier
SST	Shale Inhibitor
Staflo-Lo, Reg.	Filtrate Reducer

Tannathin	Thinner, Dispersant
Techniflo	Fluid Loss Control
Technimul	Emulsifier
Technisperse	Dispersant, Fluid Loss Control
TOR-IDF	Lubricant
Torque Kontrol	Lubricant
Torque Less (Beads)	Lubricant
Torque Trim	Lubricant
Torque Trim II	Lubricant
Ven Fibre	Lost Circulation Material
Vista ODC	Base Oil for Mud
Walnut Hulls	Lost Circulation Material
X-Pel-G.	Shale Inhibitor
Zeogel	Viscosifier

7.0 APPENDIX II

TABLES

TABLE 1: PHYSICAL DATA OF WELLS DRILLED IN ARCTIC MARINE WATERS NORTH OF 60° FOR 1985

Well Name	Latitude	Longitude	Depth(m)
Dome et al Adlartok P-09	69° 38' 52"N	137° 45' 28"W	2647*
Dome et al Arluk E-90	70° 19' 24"N	135° 26' 35"W	4300*
Dome et al Edlok N-56	69° 45' 50"N	140° 14' 22"W	2530
Dome et al Havik B-41	70° 20' 11"N	132° 13' 05"W	4750*
Dome Nerlerk J-67	70° 26' 42"N	133° 19' 29"W	4904*
Esso et al Adgo G-24	69° 23' 29"N	135° 50' 50"W	3087
Esso et al Minuk I-53	69° 42' 35"N	136° 27' 32"W	3367
Esso et al Nipterk L-19A	69° 48' 38"N	135° 19' 53"W	3520
Gulf et al Aagnerk E-56	69° 45' 16"N	136° 59' 56"W	875
Gulf et al Akpak P-35	70° 14' 52"N	134° 09" 24"W	2169*
Gulf et al Akpak 2P-35	70° 14' 52"N	134° 09' 23"W	3673
Panarctic et al Cape Allison C-47	77° 46' 05"N	100° 17' 21"W	2100
Panarctic et al East Drake L-06	76° 25' 35"N	107° 33' 18"W	1300

*Indicates a well drilled over several years

Source: The Canada Oil and Gas Lands Administration Annual Report, 1985 - p.p. 33-36.

SUMMARIES OF DRILLING FLUID ADDITIVE USE BY WELL

TABLE 2: DOME PETROLEUM LIMITED
DRILLING FLUID ADDITIVE USE BY WELL
(all measures are in kg unless otherwise indicated)

ADDITIVE	ADLARTOK	ARLUK P-09	EDLOK E-90	HAVIK N-56	NERLERK B-41	TOTAL J-67
AP21 (1)	125	1760	0	1440	10820	14145
AP21 Solid	0	0	0	0	400	400
Barite (MT)	677	537	206	730	2055	4205
Bentonite	41912	2722	49941	14243	0	108818
B Free (1)	0	0	0	0	2255	2255
Bicarbonate of Soda	2359	0	363	6214	3492	12428
Carbonox	0	0	1338	0	0	1338
Caustic Soda	112150	975	12607	1675	6213	133620
D-Foam (1)	499	0	0	0	0	499
Desco	1202	0	1984	0	0	3186
DF-Vis	0	675	0	0	0	675
Drispac - Regular	45	0	0	0	0	45
Drispac - Superlo	0	0	0	227	16862	17089
DX10(1)	10737	0	11486	0	2460	24683
FLR100E	0	0	14528	0	0	14528
Foam Kontrol (1)	204	0	0	208	205	617
Gilsonite	0	0	0	0	5085	5085
IDFLO	12347	0	9700	0	3600	25647
IDFTHIN	20875	0	0	0	0	20875
KCL	196225	27000	121500	45100	267025	656850
Kelzan (XC, XCD, XCL)	2575	431	2100	1825	9875	16806
Nutplug	0	0	454	0	0	454
Resinex	0	0	0	2994	0	2994
Safeguard 5000	0	0	0	0	416	416
SAPP	0	0	0	45	0	45
Soda Ash	318	181	1996	590	10342	13427
Sodium Sulphate	0	0	100	0	0	100
Sodium Sulphite	0	0	0	0	2100	2100
Spud Mud	1650	0	3575	0	0	5225
Staflo - Regular	7167	0	2924	0	0	10091
Staflo - Lo	3309	363	1650	1275	3000	9597
Techniflo	0	0	0	0	6396	6396
Technisperse (1)	0	2994	9300	19168	14175	45637
TOR-IDF (1)	0	0	0	0	7790	7790
Torqueless	0	0	0	0	4766	4766
Torq Kontrol (1)	0	0	2247	0	0	2247
Walnut Hulls	0	0	0	0	1362	1362
Zeogel	95708	0	139525	0	0	235233

TABLE 3: ESSO RESOURCES CANADA LIMITED
DRILLING FLUID ADDITIVE USE BY WELL
(all measures are in kg unless otherwise indicated)

ADDITIVE	ADGO G-24	MINUK I-53	NIPTERK L-19A	TOTAL
Aluminum Stearate	25	0	0	25
Barabuf	17570	0	0	17570
Barite (MT)	395	1972	351	2718
Bentonite	7763	31644	0	39407
B Free - Regular (1)	1440	0	0	1440
B Free - Hevywate (1)	205	0	0	205
Bicarbonate of Soda	0	1226	873	2099
Calcium Carbonate	0	0	500	500
Calcium Chloride	79498	46855	13250	96403
Caustic Soda	953	4158	190	5301
DMO-75 (1)	0	141000	0	141000
Duratone HT	9965	11781	0	21746
Evirospot (1)	1230	2870	0	4100
EZ Mul NT (1)	12710	29425	0	42135
EZ Spot	1025	0	0	1025
Geltone II	14800	11168	0	25968
Invermul NT (1)	20090	29930	0	50020
KCL	11725	21125	0	32850
Kelzan (XC, XCD, XCL)	275	688	0	963
Lime	7575	27700	9850	45125
Mica	25	5350	0	5375
Peltex	0	1875	182	2057
Primul (1)	0	2460	6560	9020
Sawdust	2502	2548	0	5050
Soda Ash	440	360	0	800
Sodium Sulphite	100	425	0	525
Spersene	0	960	180	1140
Technimul (1)	0	3280	6560	9840
Technisurf (1)	0	1435	0	1435
Technitrol	3496	9012	3677	16185
Technivis	0	454	5448	5902
Vista ODC (1)	636000	644000	0	1280000

TABLE 4: GULF CANADA RESOURCES INC.
DRILLING FLUID ADDITIVE USE BY WELL
(all measures are in kg unless otherwise indicated)

ADDITIVE	AAGNERK E-56	AKPAK P-35	AKPAK 2P-35	TOTAL
AP21 (1)	0	8875	0	8875
Bardac 2250 (1)	410	0	0	410
Barite (MT)	258	170	935	1363
Bicarbonate of Soda	0	0	1814	1814
Brine (1)[a]	268000	180000	992000	1440000
Caustic Soda	2011	658	2313	4982
Drispac Superlo	998	454	6827	8279
DX10 (1)	7380	0	5740	13120
Foam Kontrol (1)	205	0	410	615
Hematite	0	18000	90000	108000
IDFLO	0	1125	6300	7425
KCL	96200	24725	230750	351675
Kelzan (XC, XCD, XCL)	5100	1350	8800	15250
Kwikseal	0	653	0	653
Mica	0	150	0	150
Safeguard 5000 (1)	410	0	0	410
SAPP	0	0	120	120
Soda Ash	0	408	8709	9117
Sodium Sulphite	200	200	825	1225
Staflo X-LO	225	0	0	225
Techniflo	2449	0	0	2449
Technisperse	5264	0	9525	14789
Walnut Hulls	0	159	1222	1381

[a]Brine is a KCL/sea water mixture of varying proportions.

TABLE 5: PANARCTIC OILS LTD.
DRILLING FLUID ADDITIVE USE BY WELL
(all measures are in kg unless otherwise indicated)

ADDITIVE	CAPE ALLISON C-47	EAST DRAKE L-06	TOTAL
Attapulgite	18637	17750	36387
Barite (MT)	207	202	409
Bentonite	7037	15120	22157
B Free (1)	540	0	540
Bicarbonate of Soda	1498	909	2407
Calcium Chloride	0	182	182
Caustic Soda	4600	2200	6800
Diesel (1)	5280	0	5280
Kelzan (XC, XCD, XCL)	6825	5075	11900
KlD97	0	1375	1375
Sawdust	575	240	815
Soda Ash	182	0	182
Spersene	0	205	205
Staflo	3225	1625	4850

COMPARISON OF ESTIMATED AND ACTUAL DRILLING FLUID ADDITIVE USE

TABLE 6: DOME PETROLEUM LIMITED
COMPARISON OF ESTIMATED AND ACTUAL DRILLING FLUID ADDITIVE USE
(all measures are in kg unless otherwise indicated)

ADDITIVE	4 WELLS ESTIMATE[a]	4 WELLS TOTAL[a]	NERLERK J-67 ESTIMATED	NERLERK J-67 ACTUAL
Aluminum Stearate	A.R.	0	0	0
AP21 (1)	280000	3325	3168	10820
AP21 Solid	0	0	0	400
Barite (MT)	22000	2150	779	2055
Bentonite	50000	108818	0	0
BFree (1)	A.R.	0	0	2255
Bicarbonate of Soda	20000	8936	2025	3492
Carbonox	A.R.	1338	0	0
Caustic Soda	215000	127407	36850	6213
D-Foam (1)	0	499	0	0
Densimix	83000	0	0	0
Desco	27000	3186	0	0
DF Vis	A.R.	675	0	0
Drispac - Regular	15000	45	0	0
Drispac - Superlo	82000	227	9725	16862
DX10 (1)	A.R.	22223	23000	2460
FLR100E	A.R.	14528	0	0
Foam Kontrol (1)	A.R.	412	1000	205
Gilsonite	0	0	0	5085
IDFLO	87000	22047	22375	3600
IDFTHIN	350000	20875	0	0
KCL	1600000	389825	209300	267025
Kelzan (XC, XCD, XCL)	A.R.	6931	16050	9875
Kwik Seal	A.R.	0	0	0
Magconol (1)	A.R.	0	0	0
Mica	A.R.	0	0	0
N'oxygen	A.R.	0	0	0
Nut Plug	A.R.	454	0	0
Poly RX	28000	0	0	0
Resinex	0	2994	0	0
Safeguard 5000 (1)	A.R.	0	0	416
SAPP	A.R.	45	0	0
Shale Kontrol	A.R.	0	66750	0
Soda Ash	48000	3085	4185	10342
Sodium Sulphate	0	100	0	0
Sodium Sulphite	A.R.	0	1825	2100
Soltex	A.R.	0	0	0
Spud Mud	0	5225	0	0
SST	135000	0	0	0
Staflo - Regular	A.R.	10091	0	0
Staflo - XLO	A.R.	6597	0	3000
Techniflo	0	0	0	6396
Technisperse (1)	A.R.	31462	47225	14175
TOR-IDF (1)	0	0	0	7790
Torqueless	0	0	0	4766
Torq Kontrol (1)	0	2247	0	0
Torq Trim (1)	18000	0	0	0
Walnut Hulls	A.R.	0	0	1362

	ESTIMATE[a]	TOTAL[a]	J-67 ESTIMATED	J-67 ACTUAL
Aluminum Stearate	A.R.	0	0	0
AP21 (1)	280000	3325	3168	10820
AP21 Solid	0	0	0	400
Barite (MT)	22000	2150	779	2055
Bentonite	50000	108818	0	0
BFree (1)	A.R.	0	0	2255
Bicarbonate of Soda	20000	8936	2025	3492
Carbonox	A.R.	1338	0	0
Caustic Soda	215000	127407	36850	6213
D-Foam (1)	0	499	0	0
Densimix	83000	0	0	0
Desco	27000	3186	0	0
DF Vis	A.R.	675	0	0
Drispac - Regular	15000	45	0	0
Drispac - Superlo	82000	227	9725	16862
DX10 (1)	A.R.	22223	23000	2460
FLR100E	A.R.	14528	0	0
Foam Kontrol (1)	A.R.	412	1000	205
Gilsonite	0	0	0	5085
IDFLO	87000	22047	22375	3600
IDFTHIN	350000	20875	0	0
KCL	1600000	389825	209300	267025
Kelzan (XC, XCD, XCL)	A.R.	6931	16050	9875
Kwik Seal	A.R.	0	0	0
Magconol (1)	A.R.	0	0	0
Mica	A.R.	0	0	0
N'oxygen	A.R.	0	0	0
Nut Plug	A.R.	454	0	0
Poly RX	28000	0	0	0
Resinex	0	2994	0	0
Safeguard 5000 (1)	A.R.	0	0	416
SAPP	A.R.	45	0	0
Shale Kontrol	A.R.	0	66750	0
Soda Ash	48000	3085	4185	10342
Sodium Sulphate	0	100	0	0
Sodium Sulphite	A.R.	0	1825	2100
Soltex	A.R.	0	0	0
Spud Mud	0	5225	0	0
SST	135000	0	0	0
Staflo - Regular	A.R.	10091	0	0
Staflo - XLO	A.R.	6597	0	3000
Techniflo	0	0	0	6396
Technisperse (1)	A.R.	31462	47225	14175
TOR-IDF (1)	0	0	0	7790
Torqueless	0	0	0	4766
Torq Kontrol (1)	0	2247	0	0
Torq Trim (1)	18000	0	0	0
Walnut Hulls	A.R.	0	0	1362
X-Pel-G	A.R.	0	0	0
Zeogel	0	235233	0	0

[a]Dome did not supply individual well estimates for the Adlartok, Arluk, Edlok and Havik wells. Hence, only totals can be compared.

A.R. means - As Required.

TABLE 6B: DOME PETROLEUM LIMITED
PERCENTAGE VARIANCE BETWEEN ESTIMATED AND
ACTUAL DRILLING FLUID ADDITIVE USE
(calculated as (Actual - Estimated/Actual)* 100)

ADDITIVE	4 WELL[a]	NERLERK
Aluminum Stearate	-	-
AP21	- 742.1	70.7
AP21 Solid	-	100.0
Barite	- 923.3	62.1
Bentonite	54.1	-
B Free	-	-
Bicarbonate of Soda	- 123.8	42.0
Carbonox	100.0	-
Caustic Soda	- 68.8	- 493.1
D-Foam	100.0	-
Densimix	n/u	-
DESCO	- 747.5	-
DF-Vis	100.0	-
Drispac - Regular	-33230.0	-
Drispac - Superlo	-36020.0	42.3
DX-10	100.0	- 835.0
FLR100E	100.0	-
Foam Kontrol	100.0	- 387.8
Gilsonite	-	100.0
IDFLO	- 294.6	- 521.5
IDFTHIN	- 1577.0	-
KCL	- 311.0	21.6
Kelzan (XC,XCD,XCL)	100.0	- 62.5
Kwik Seal	-	-
Magconol	-	-
Mica	-	-
N'oxygen	-	-
Nut Plug	100.0	-
Poly Rx	n/u	-
Resinex	100.0	-
Safeguard 5000	-	100.0
SAPP	100.0	-
Shale Kontrol	-	n/u
Soda Ash	- 1456.0	59.5
Sodium Sulphate	100.0	-
Sodium Sulphite	-	13.1
Soltex	-	-
Spud Mud	100.0	-
SST	n/u	-
Staflo - Regular	100.0	-
Staflo - XLO	100.0	100.0
Techniflo	-	100.0
Technisperse	100.0	- 233.2
TOR-IDF	-	100.0
Torq Kontrol	100.0	-
Torq Trim	n/u	-
Walnut Hulls	-	100.0
X-Pel-G	-	-
Zeogel	100.0	-
Standard Deviation	890.7	262.6
Average	- 2543.0	- 60.1
Count	29	22

AP21	- 742.1	70.7
AP21 Solid	-	100.0
Barite	- 923.3	62.1
Bentonite	54.1	-
B Free	-	-
Bicarbonate of Soda	- 123.8	42.0
Carbonox	100.0	-
Caustic Soda	- 68.8	- 493.1
D-Foam	100.0	-
Densimix	n/u	-
DESCO	- 747.5	-
DF-Vis	100.0	-
Drispac - Regular	-33230.0	-
Drispac - Superlo	-36020.0	42.3
DX-10	100.0	- 835.0
FLR100E	100.0	-
Foam Kontrol	100.0	- 387.8
Gilsonite	-	100.0
IDFLO	- 294.6	- 521.5
IDFTHIN	- 1577.0	-
KCL	- 311.0	21.6
Kelzan (XC,XCD,XCL)	100.0	- 62.5
Kwik Seal	-	-
Magconol	-	-
Mica	-	-
N'oxygen	-	-
Nut Plug	100.0	-
Poly Rx	n/u	-
Resinex	100.0	-
Safeguard 5000	-	100.0
SAPP	100.0	-
Shale Kontrol	-	n/u
Soda Ash	- 1456.0	59.5
Sodium Sulphate	100.0	-
Sodium Sulphite	-	13.1
Soltex	-	-
Spud Mud	100.0	-
SST	n/u	-
Staflo - Regular	100.0	-
Staflo - XLO	100.0	100.0
Techniflo	-	100.0
Technisperse	100.0	- 233.2
TOR-IDF	-	100.0
Torq Kontrol	100.0	-
Torq Trim	n/u	-
Walnut Hulls	-	100.0
X-Pel-G	-	-
Zeogel	100.0	-
Standard Deviation	890.7	262.6
Average	- 2543.0	- 60.1
Count	29	22

[a]If the estimate (from Table 6) was As Required, it is assumed to be zero for the purposes of this calculation.

n/u - The product was planned for but not used.

TABLE 7: ESSO RESOURCES CANADA LIMITED
COMPARISON OF ESTIMATED AND ACTUAL DRILLING FLUID ADDITIVE USE
(all measures are in kg unless otherwise indicated)

ADDITIVE	ADGO G-24		MINUK I-53		NIPTERK L-19A	
	ESTIMATED	ACTUAL	ESTIMATED	ACTUAL	ESTIMATED	ACTUAL
Aluminum Stearate	400	25	400	0	0	0
Barabuf	17933	17570	45400	0	0	0
Barite (Mt)	609	395	3339	1972	342	351
Bentonite	48000	7763	98000	31644	0	0
B Free - Regular (1)	1000	1440	1000	0	0	0
B Free - Hevywate (1)	0	205	0	0	0	0
Bicarbonite of Soda	2200	0	4000	1226	0	873
Biotrol (1)	0	0	100	0	0	0
Calcium Carbonate	9600	0	9600	0	19400	500
Calcium Chloride	21200	79498	60330	46855	255	13250
Capryl Alcohol (1)	450	0	250	0	0	0
Caustic Soda	4200	953	10000	4158	0	190
CMC	625	0	625	0	0	0
DMO-75 (1)	0	0	0	141000	45000	0
Duratone HT	3700	9965	10000	11781	0	0
Envirospot (1)	1230	1230	3280	2870	0	0
EZ Mul NT (1)	8200	12710	16400	29425	0	0
EZ Spot	0	1025	0	0	0	0
Geltone II	17820	14800	39300	11168	0	0
Invermul NT (1)	9430	20090	20100	29930	0	0
KCl	35000	11725	50000	21125	0	0
Kelzan (XC, XCD, XCL)	2400	275	9500	688	0	0
Kwik Seal	750	0	1000	0	0	0
Lime	3050	7575	5500	27700	0	9850
Mica	9600	25	9200	5350	0	0
Paraformaldehyde	200	0	200	0	0	0
Peltex	1000	0	3800	1875	0	182
Primul (1)	0	0	3280	2460	5850	6560
SAPP	350	0	200	0	0	0
Sawdust	18000	2502	5000	2548	0	0
Soda Ash	3000	440	2500	360	0	0
Sodium Sulphite	1000	100	4800	425	0	0
Spersene	0	0	0	960	0	180
Techimul (1)	0	0	3280	3280	5850	6560
Technisurf (1)	0	0	1020	1435	0	0
Technitrol	0	3496	0	9012	9700	3677
Technivis	0	0	10900	454	9700	5448
Torque Trim II (1)	1000	0	1000	0	0	0
Ven Fibre	9600	0	9600	0	0	0
VISTA ODC (1)	0	636000	0	644000	0	0
Walnut Hulls	5800	0	5800	0	0	0

TABLE 7B: ESSO RESOURCES CANADA LIMITED
PERCENTAGE VARIANCE BETWEEN ESTIMATED
AND ACTUAL DRILLING FLUID ADDITIVE USE
(calculated as ((Actual-Estimate)/Actual)*100)

ADDITIVE	ADGO G-24	MINUK I-53	NIPTERK L-19A
Aluminum Stearate	- 1500.0	-	Not Used(n/u)
Barabuf	- 2.1	n/u	-
Barite	- 54.2	- 69.4	2.5
Bentonite	- 518.3	- 209.7	-
B Free - Regular	30.6	n/u	-
B Free - Hevywate	100.0	-	-
Bicarbonate of Soda	n/u	- 226.3	100.0
Biotrol	-	n/u	-
Calcium Carbonate	n/u	n/u	-3780.0
Calcium Chloride	41.6	- 28.8	98.1
Caustic Soda	- 340.7	- 140.5	100.0
CMC	n/u	n/u	-
DMO-75	-	100.0	n/u
Duratone HT	62.9	15.1	-
Evirospot	0.0	- 14.3	-
EZ Mul NT	35.5	44.3	-
EZ Spot	100.0	-	-
Geltone II	- 20.4	- 251.9	-
Invermul NT	53.1	32.8	-
KCl	- 198.5	- 136.7	-
Kelzan (XC, XCD, XCL)	- 772.7	-1281.0	-
Kwik Seal	n/u	n/u	-
Lime	59.7	80.1	100.0
Mica	-38300.0	- 72.0	-
Paraformaldehyde	n/u	n/u	-
Peltex	n/u	- 102.7	100.0
Primul	-	- 33.3	10.8
SAPP	n/u	n/u	-
Sawdust	- 619.4	916.2	-
Soda Ash	- 581.8	- 594.4	-
Sodium Sulphite	- 900.0	-1029.0	-
Spersene	-	100.0	100.0
Technimul	-	0.0	10.8
Technisurf	-	28.9	-
Technitrol	100.0	100.0	- 163.8
Technivis	-	-2301.0	- 78.1
Torque Trim II	n/u	n/u	-
VenFibre	n/u	n/u	-
VISTA ODC	100.0	100.0	-
Walnut Hulls	n/u	n/u	-
Standard Deviation	7951.2	538.5	1104.5
Average	- 1875.0	- 230.2	-2883.0
Count	23	26	12

n/u - The product was planned for but not used.

TABLE 8: GULF CANADA RESOURCES INC.
COMPARISON OF ESTIMATED AND ACTUAL DRILLING FLUID ADDITIVE USE
(all measures are in kg unless otherwise noted)

ADDITIVE	AAGNERK E-56		AKPAK P-35		AKPAK 2P-35	
	ESTIMATED	ACTUAL	ESTIMATED	ACTUAL	ESTIMATED	ACTUAL
AP21 (1)	0	0	9325	8875	14825	0
Bandac 2250 (1)	0	410	0	0	0	0
Barite (MT)	237	258	393	170	564	935
Bicarbonate of Soda	900	0	900	0	1665	1814
Brine (1)	0	268000	0	180000	0	992000
Caustic Soda	10775	2011	24750	658	32975	2313
Drispac Superlo	0	998	0	454	5975	6827
DX10 (1)	8400	7380	18800	0	21600	5740
Foam Kontrol (1)	200	205	600	0	800	410
Hematite	0	0	0	18000	0	90000
IDFLO	8400	0	22375	1125	22375	6300
KCl	85775	96200	147875	24725	184425	230750
Kelzan (XC, XCD, XCL)	8350	5100	12250	1350	14550	8800
Kwik Seal	0	0	0	653	0	0
Mica	0	0	0	150	0	0
Safeguard 5000 (1)	0	410	0	0	0	0
SAPP	0	0	0	0	0	120
Shale Kontrol	19525	0	44850	0	59750	0
Soda Ash	1215	0	2790	408	3735	8709
Sodium Sulphite	525	200	1200	200	1625	825
StaFlo X-Lo	0	225	0	0	0	0
Techniflo	0	2449	0	0	0	0
Technisperse	0	5264	25325	0	40225	9525
Walnut Hulls	0	0	0	159	0	1222

TABLE 8B: GULF CANADA RESOURCES INC.
PERCENTAGE VARIANCE BETWEEN ESTIMATED
AND ACTUAL DRILLING FLUID ADDITIVE USE
(calculated as ((Actual-Estimated)/Actual)*100)

ADDITIVE	AAGNERK E-56	AKPAK P-35	AKPAK 2P-35
AP21 (1)	-	- 5.1	Not Used(n/u)
Bandac 2250 (1)	100.0	-	-
Barite (MT)	8.1	- 131.2	39.7
Bicarbonate of Soda	n/u	n/u	8.2
Brine (1)	100.0	100.0	100.0
Caustic Soda	- 435.8	-3661.0	-1326.0
Drispac Superlo	100.0	100.0	12.5
DX10 (1)	- 13.82	n/u	- 276.3
Foam Kontrol (1)	2.4	n/u	- 95.1
Hematite	-	100.0	100.0
IDFLO	n/u	-1889.0	- 255.2
KCl	10.8	- 489.1	20.1
Kelzan (XC, XCD, XCL)	- 63.7	- 807.4	- 65.34
Kwik Seal	-	100.0	-
Mica	-	100.0	-
Safeguard 5000 (1)	100.0	-	-
SAPP	-	-	100.0
Shale Kontrol	n/u	n/u	n/u
Soda Ash	n/u	- 583.8	57.1
Sodium Sulphite	- 162.5	- 500.0	- 97.0
StaFlo X-Lo	100.0	-	-
Techniflo	100.0	-	-
Technisperse	100.0	n/u	- 322.3
Walnut Hulls	-	100.0	100.0
Standard Deviation	149.52	1057.9	350.8
Average	3.3	- 534.0	- 118.7
Count	14	14	16

n/u - Product planned for but not used.

TABLE 9: PANARCTIC OILS LTD.
COMPARISON OF ESTIMATED AND ACTUAL DRILLING FLUID USE
(all measures are in kg unless otherwise indicated)

ADDITIVE	CAPE ALLISON C-47		EAST DRAKE L-09	
	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL
Attapulgite	11300	18637	5700	17750
Barite (MT)	240	207	200	202
Bentonite	18900	7037	8100	15120
B Free (l)	500	540	0	0
Bicarbonate of Soda	1500	1498	1100	909
Calcium Chloride	2000	0	0	182
Caustic Soda	3800	4600	3800	2200
Diesel (l)	0	5280	0	0
Kelzan (XC, XCD, KCL)	7500	6825	7500	5075
Kwik Seal	6600	0	2000	0
KID97	0	0	0	1375
Lime	700	0	300	0
Mica	2000	0	2500	0
Sawdust	5200	575	1600	240
Soda Ash	0	182	0	0
Spersene	1300	0	0	205
StaFlo	1400	3225	1200	1625
Torqueless	1400	0	0	0
Walnut Hulls	2000	0	1100	0

TABLE 9B: PANARCTIC OILS LTD.
PERCENTAGE VARIANCE BETWEEN ESTIMATED
AND ACTUAL DRILLING FLUID ADDITIVE USE
(calculated as ((Actual-Estimated)/Actual)*100)

ADDITIVE	CAPE ALLISON C-47	EAST DRAKE L-09
Attapulgite	- 39.4	- 67.9
Barite	- 15.9	1.0
Bentonite	-168.6	46.4
B Free	8.0	-
Bicarbonate of Soda	0.1	- 21.0
Calcium Chloride	Not used (n/u)	100.0
Caustic Soda	17.4	- 72.7
Diesel	100.0	-
Kelzan (XC, XCD, KCL)	- 9.9	- 47.8
Kwik Seal	n/u	n/u
KID97	-	100.0
Lime	n/u	n/u
Mica	n/u	n/u
Sawdust	-804.3	- 566.7
Soda Ash	100.0	-
Spersene	n/u	100.0
StaFlo	56.6	26.2
Torqueless	n/u	-
Walnut Hulls	n/u	n/u
Standard Deviation	256.7	189.8
Average	- 61.6	- 24.25
Count	11	11

n/u - Product was planned for but not used.

DRILLING WASTE VOLUMES
BY WELL

NOTE: These summaries do not include accidental or unauthorized discharges, such as spills.

TABLE 10: DOME PETROLEUM LIMITED
DRILLING WASTE SUMMARY BY WELL
(all volumes are in m^3)

WELL	CUTTINGS/SOLIDS CONTROL	MUD	TOTAL
Adlartok P-09	1447.7	1699.0	3146.7
Arluk E-90	35.0	347.0	409.0
Edlok N-56	1526.7	2256.0	3782.7
Havik B-41	52.2	386.5	438.7
Nerlerk J-67	2644.8	591.0[a]	3235.8
Total	5706.4	5306.5	

[a]Includes 179m^3 left in the hole from the previous drilling season.

TABLE 11: ESSO RESOURCES CANADA LIMITED
DRILLING WASTE SUMMARY BY WELL
(all volumes are in m^3)

WELL	CUTTINGS/SOLIDS CONTROL	MUD	OTHER	TOTAL
Adgo G-24	[a]	265.5[b]	-	265.5
Minuk I-53	696.9	888 - Water Based Mud	-	1584.9
	-	774.5 - Oil Based Mud	344.7	1119.2
Nipterk L-19	[c]	45.0[b]	-	45.0
Total	696.9	1973.0	344.7	

[a]Cuttings were collected and held pending a possible ocean dumping in the 1986 winter season. These were subsequently shipped to land for disposal.

[b]Only water based mud was discharged, all oil based mud was collected and held for reuse.

[c]Cuttings were shipped to land for disposal.

TABLE 12: GULF CANADA RESOURCES INC.
DRILLING WASTE SUMMARY BY WELL
(all volumes are in m^3)

WELL	CUTTINGS/SOLIDS CONTROL	MUD	TOTAL
Aagnerk E-56	414.0/575.2	818.0	1807.2
Akpak P-35	160.0[a]	18.0	182.0
Akpak 2P-25	174.0/2419.0	566.0	3126.0
Total	3746.2	1402.0	

[a]No differentation was made.

TABLE 13: PANARCTIC OILS LTD.
DRILLING WASTE SUMMARY BY WELL
(all volumes are in m^3)

WELL	CUTTINGS	SOLIDS CONTROL	MUD	HYDRAULIC FLUID	TOTAL
Cape Allison C-47	154.2	412.4	424.0	18.6	1009.2
East Drake L-09	124.6	65.0	410	10.8	610.4
Total	278.8	477.4	834.0	29.4	

TABLE 14: DRILLING FLUID ADDITIVES
WITH TOXICITY (LC_{50}) OF 1000 PPM OR LESS
USED IN ARCTIC MARINE WATERS NORTH OF 60°
(all measures are in Kg. unless otherwise indicated)

ADDITIVE	LC_{50}	BEAUFORT SEA	HIGH ARCTIC	TOTAL
Bardac 2250 (1)	1	410	-	410
BFree (Regular, Hevywate) (1)	7	3860	540	4400
Caustic Soda	105	143903	6800	150703
Desco	105	3186	-	3186
DF-Vis	1000	675	-	675
Diesel(1)	1	-	5280	5280
DM075 (1)	*	141000	-	141000
Duratone HT	30	21476	-	21746
DX10 (1)	320	37803	-	37803
EZ Spot	900	1025	-	1025
Foam Kontrol (1)	550	1232	-	1232
Lime	50	45125	-	45125
Safeguard 5000 (1)	120	826	-	826
SAPP	870	165	-	165
Soda Ash	75	23364	182	23546
Technimul (1)	135	9840	-	9840
Technisurf (1)	4	1435	-	1435
TORIDF (1)	160	7790	-	7790
Torq Kontrol	160	2247	-	2247
VISTA ODC	590	1280000	-	1280000

*Data unavailable - believed to be less than 590.

8.0 APPENDIX III

FIGURES SHOWING LINE OF BEST FIT
FOR
SELECTED DRILLING FLUID ADDITIVES USED
VS.
WELL DEPTH

TOTAL BARITE USE BY WELL
(ALL WELLS - 1983 TO 1985)

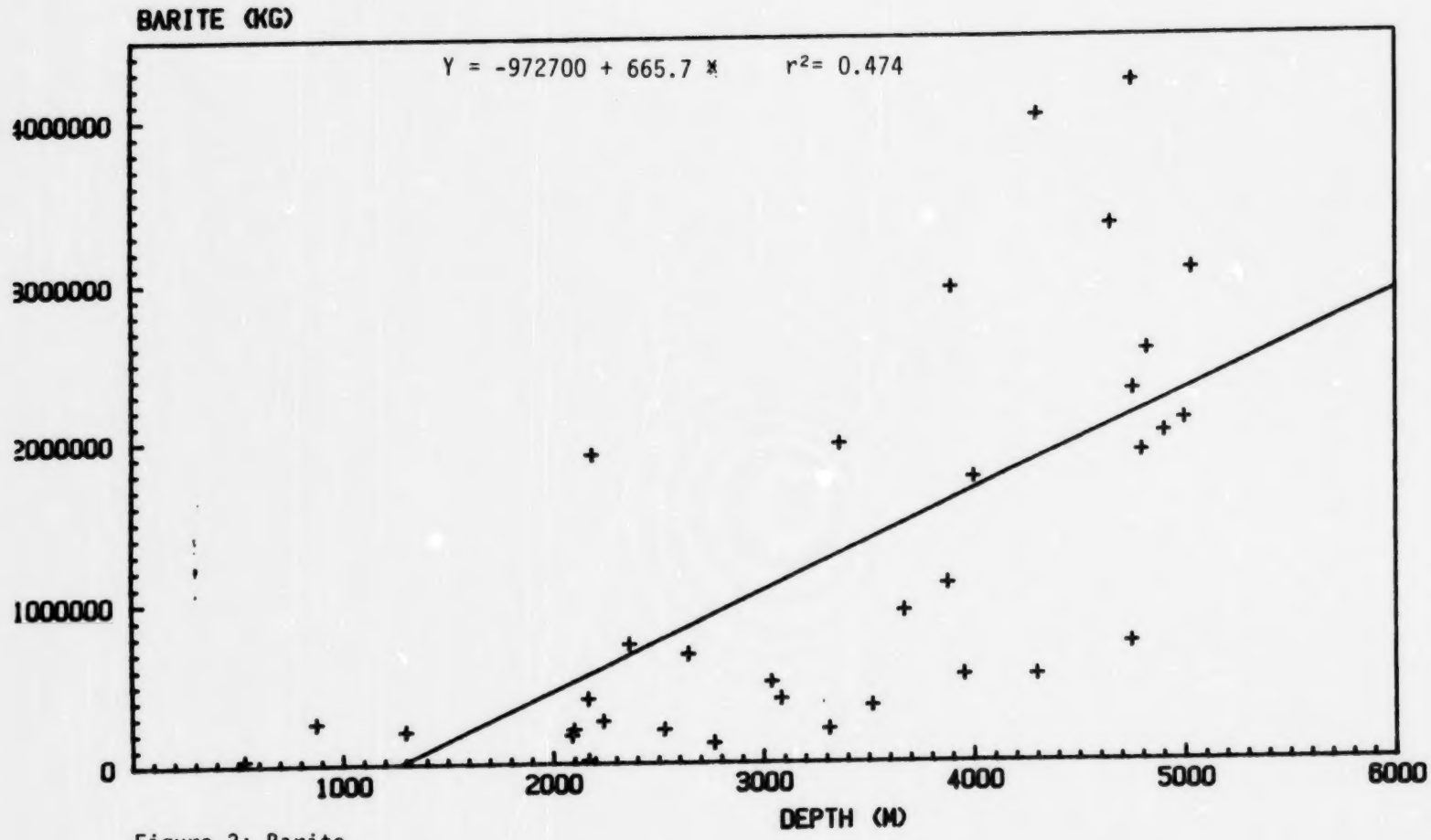

Figure 3: Barite

TOTAL BENTONITE USE BY WELL
(ALL WELLS - 1983 TO 1985)

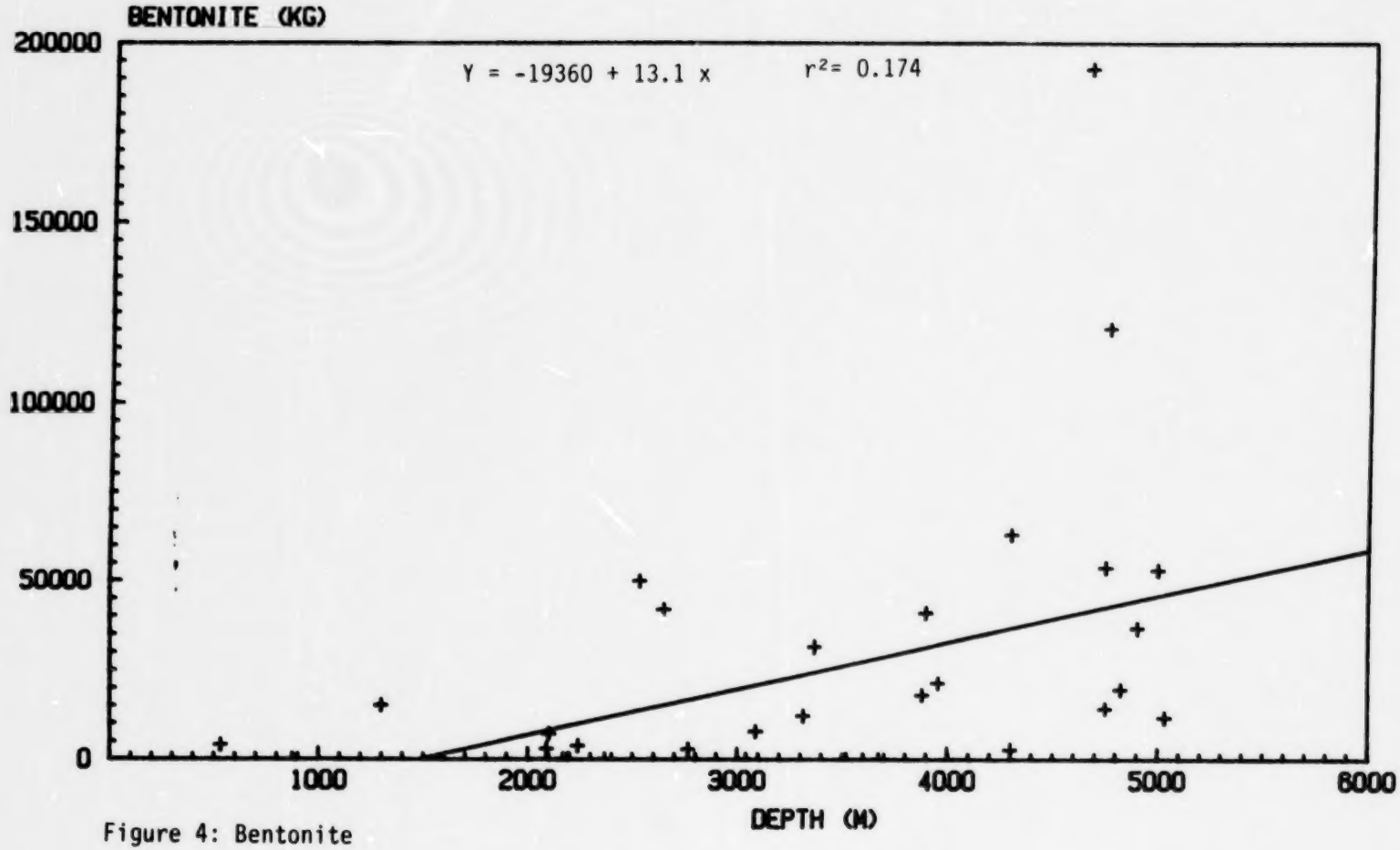

Figure 4: Bentonite

SODIUM BICARBONATE USE BY WELL
(ALL WELLS - 1983 TO 1985)

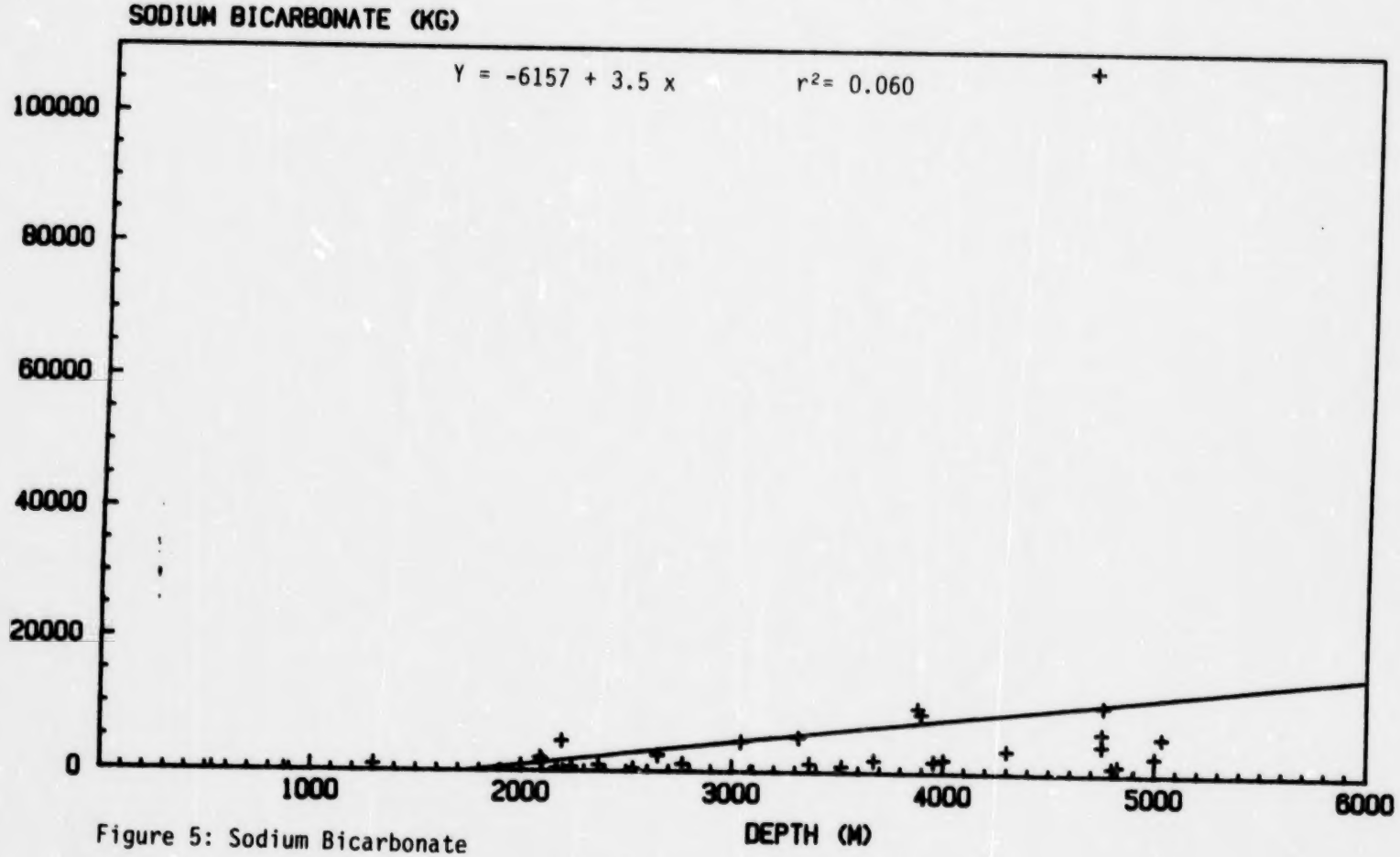

Figure 5: Sodium Bicarbonate

TOTAL CAUSTIC SODA USE BY WELL
(ALL WELLS - 1983 TO 1985)

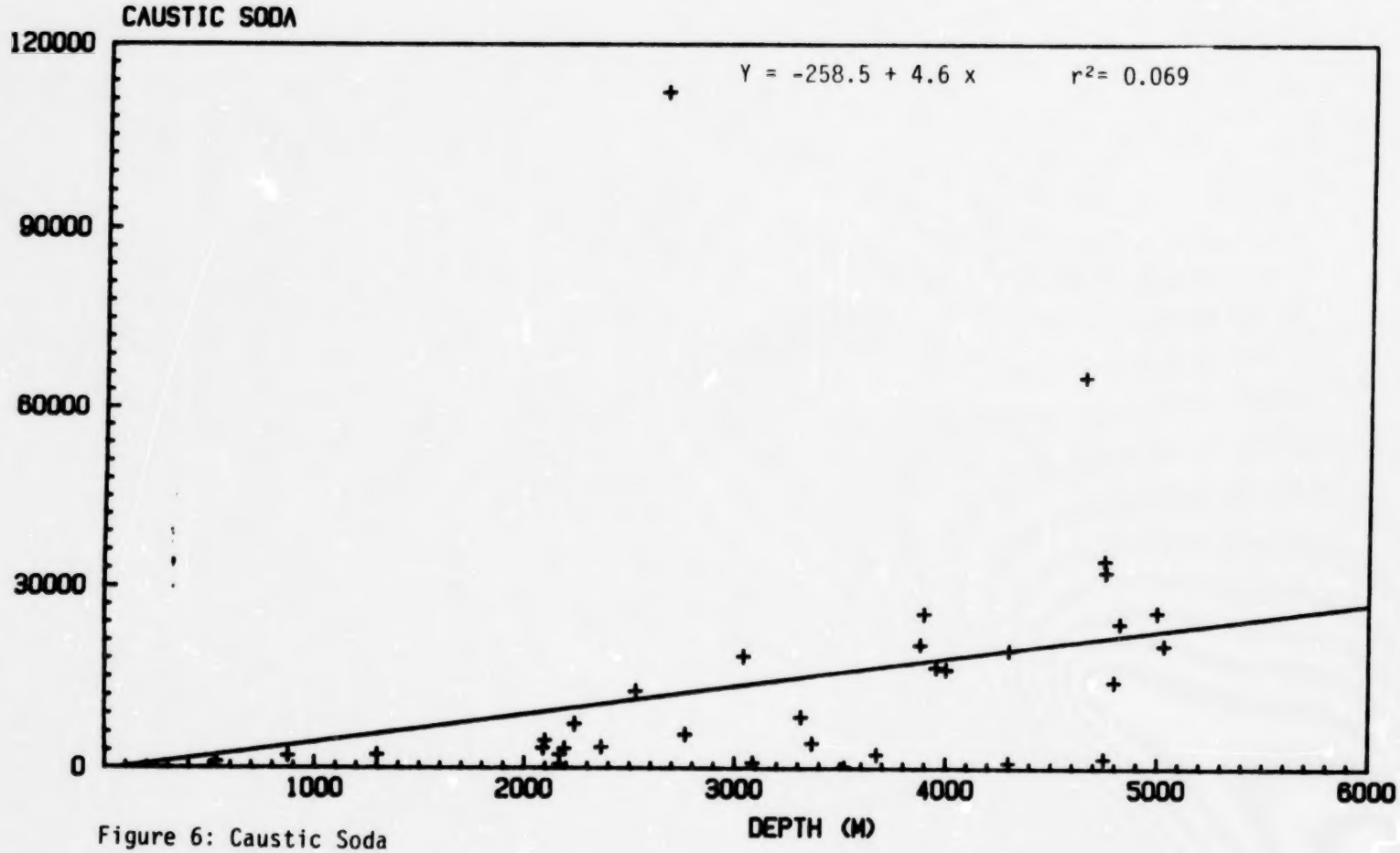

Figure 6: Caustic Soda

TOTAL KCL/POTASH USE BY WELL
(ALL WELLS - 1983 TO 1985)

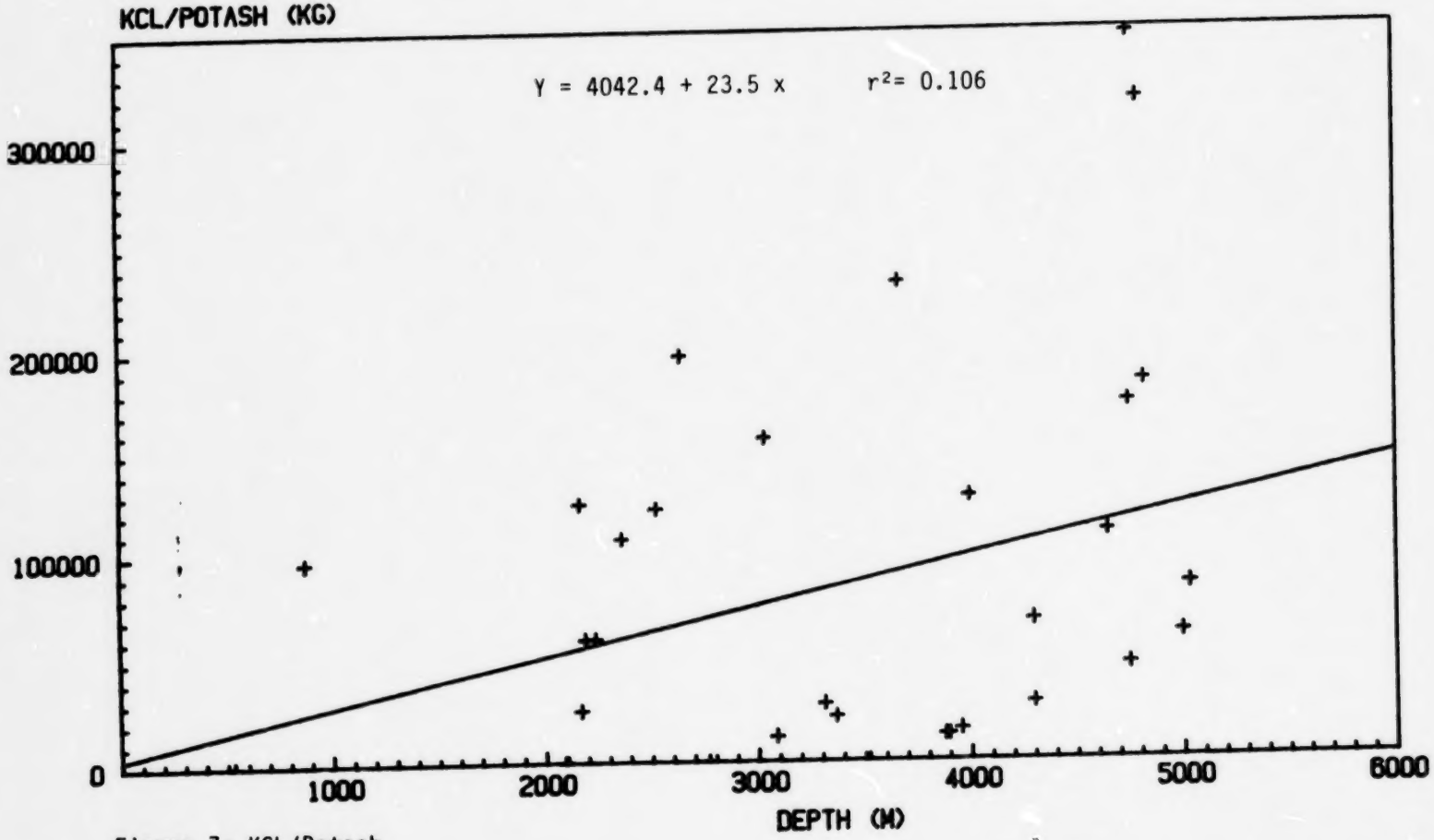

Figure 7: KCL/Potash

TOTAL SODA ASH USE BY WELL
(ALL WELLS - 1983 TO 1985)

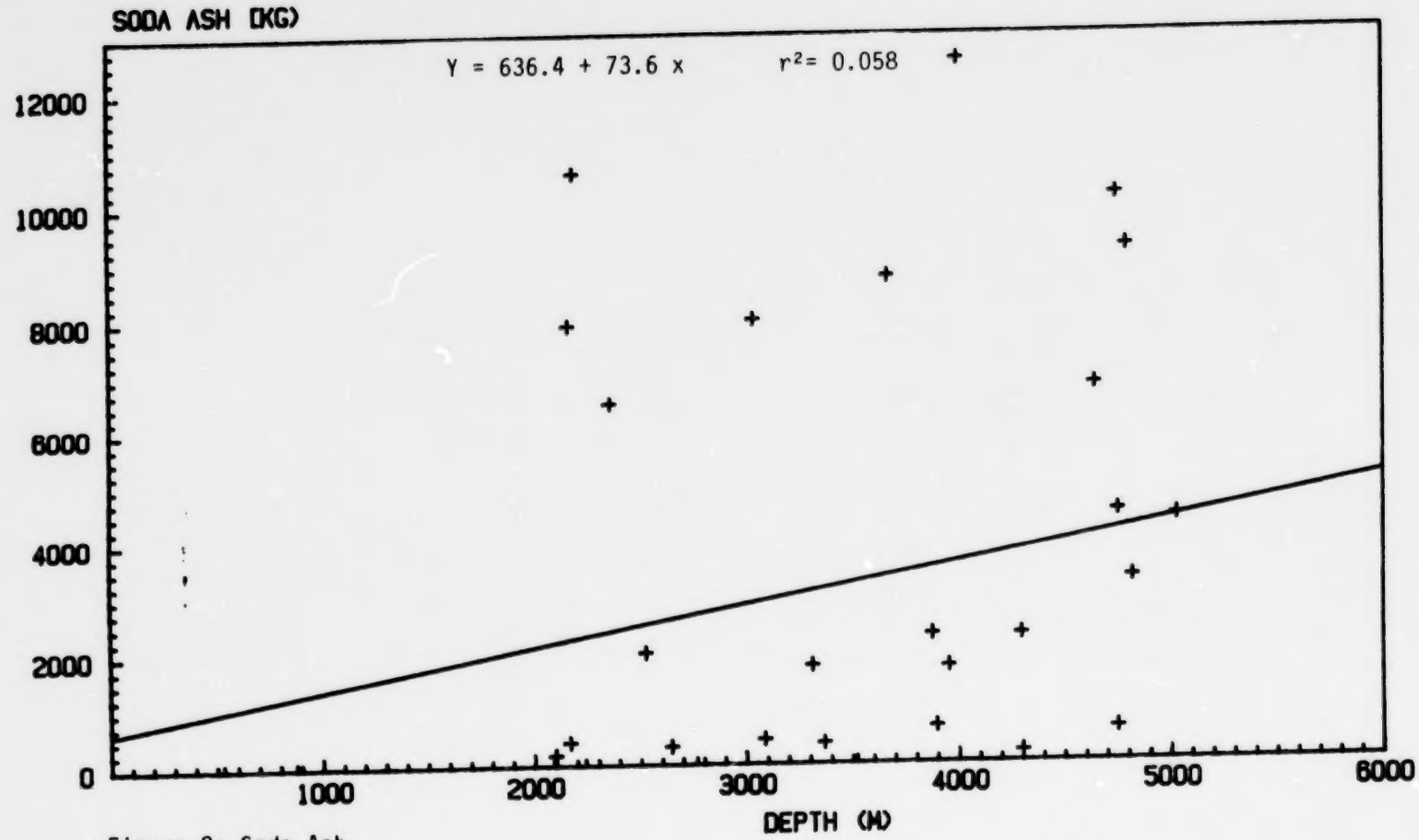

Figure 8: Soda Ash

TOTAL XC/KELZAN USE BY WELL
(ALL WELLS - 1983 TO 1985)

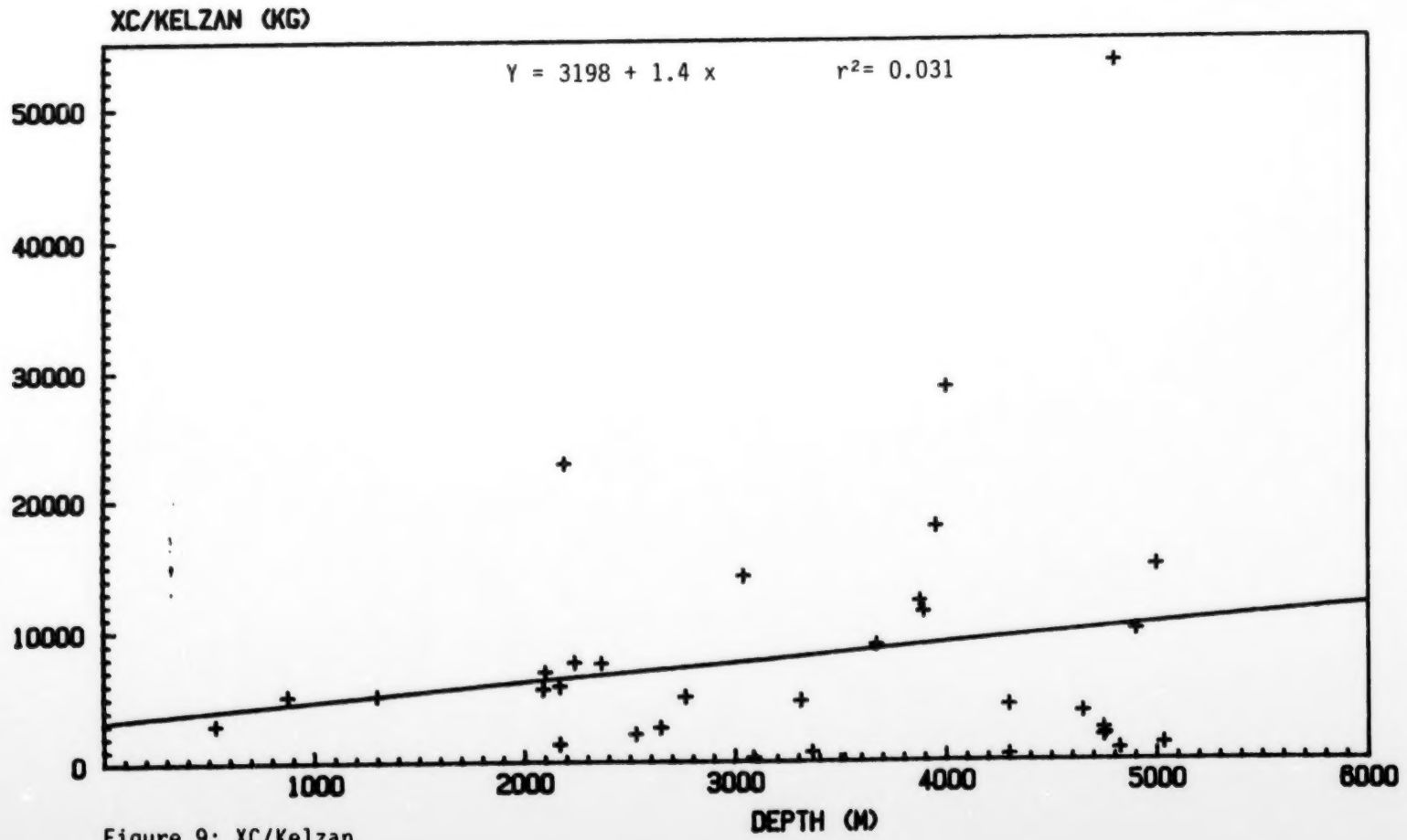

Figure 9: XC/Kelzan